MICROCOMPUTER ADAPTATION OF A TECHNICAL MANUAL

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ABSTRACT

The Tri-Service Manual "Structures to Resist the Effects of Accidental Explosions", has recently been revised and published. The latest version of this technical manual contains updated information on a variety of explosion effects and structural response. The manual has been adopted for microcomputer usage by the Structural Mechanics Division, Structures Laboratory, US Army Waterways Experiment Station, in the form of a microcomputer program presented by this paper. This program allows the user to display the text of the manual on a microcomputer monitor, search for key words and phrases, display the figures from the manual on a monitor, produce hard copies on a plotter, retrieve data points from curves, and perform a variety of response calculations.

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Introduction

The U.S. Army Armament Research, Development and Engineering Center (ARDEC) has recently completed a revision of the Tri-Service Manual "Structures to Resist the Effects of Accidental Explosions". Pending approval of this draft revision as a Tri-Service Manual, the six-volume set has been published as Special Publication ARLCD-SP-84001 by ARDEC (Reference 1). To avoid confusion, this manual will be referred to by its Army designation, TM 5-1300, throughout this text. The latest version of this technical manual contains updated information on a variety of explosion effects and structural response. The manual has been adopted for microcomputer usage by the Structural Mechanics Division, Structures Laboratory, U.S. Army Engineer Waterways Experiment Station (WES), in the form of the computer program presented here -- TM.

TM allows the user to display the text of the manual on a microcomputer monitor and search for key words and phrases. It also allows the user to display the figures from the manual on a monitor, produce hard copies on a plotter, retrieve data points from curves, and compare test data to the theoretical curves from the manual.

Displaying Text

TM is a menu-driven program written for commonly available desktop computers using the Disk Operating System (DOS). From the program's main menu, the user may select to: read or print the table of contents, appendices, or body of any of Volumes 1-6 from TM 5-1300; select a subject from an index; or display the figures of the manual.

While displaying text from TM 5-1300, all of the functions of TM are controlled by the PC's cursor control keys and function keys. The cursor control keys are used to scroll up or down one line or one screen at a time. Scrolling may be repeated rapidly by holding down the cursor control keys. In addition, the function keys enable the user to search either forward or backward through the text for a key word or phrase. The search is not case sensitive. The user may also place a temporary "bookmark" at one place in a passage of text for later return. With the proper hardware, the user may also: change the current screen colors; switch to 43 lines of text per screen (rather than the normal 25); and speed up the keyboard response for faster scrolling.

Displaying Figures

Data for most of the figures from the manual is stored in separate files. The data files for illustrations are of one of three forms: 1) Hewlett-Packard Graphics Language (HPGL) instructions, 2) Tagged Image File Format (TIFF) bit-

mapped images, or 3) Files containing drawing instructions recognized by TM (see Figures 1 and 2). The data files for figures consisting of curves (Figure 3) contain either the data points necessary to recreate the curves, or the coefficients and exponents of polynomial equations used to generate the curves. In the latter case, TM will generate 200 equally spaced data points for each curve in the figure. Figures may be reproduced on most commonly available microcomputer graphics adapter/monitor combinations and on pen plotters supporting the Hewlett-Packard Graphics Language.

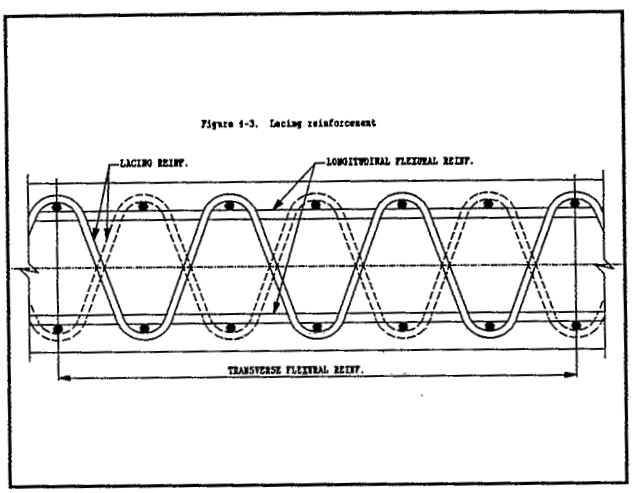

Figure 1. Illustration of lacing reinforcement (Fig. 4-3, Ref. 1)

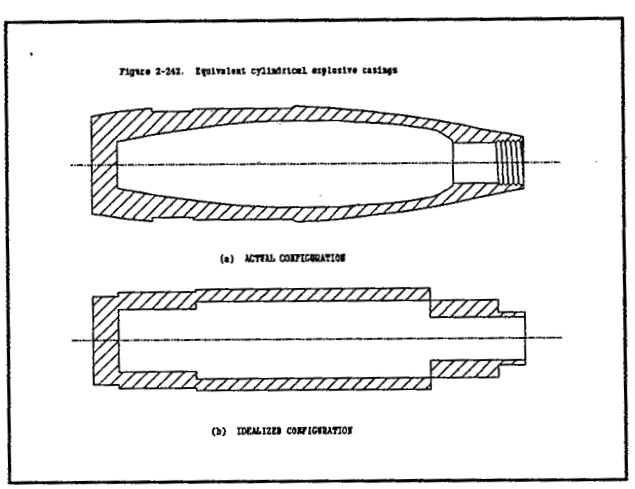

Figure 2. Equivalent cylindrical explosive casings (Fig. 2-242, Ref. 1)

If the selected figure consists of a curve or a set of curves (rather than an illustration), the user has the options of retrieving data points from a curve

or zooming in on a portion of a curve. An example of the zoom feature is shown in Figures 3 and 4. The data retrieval function returns a Y value which is interpolated from the data points for each figure. The accuracy of this function is dependent on the spacing between data points, not on the resolution of the display monitor.

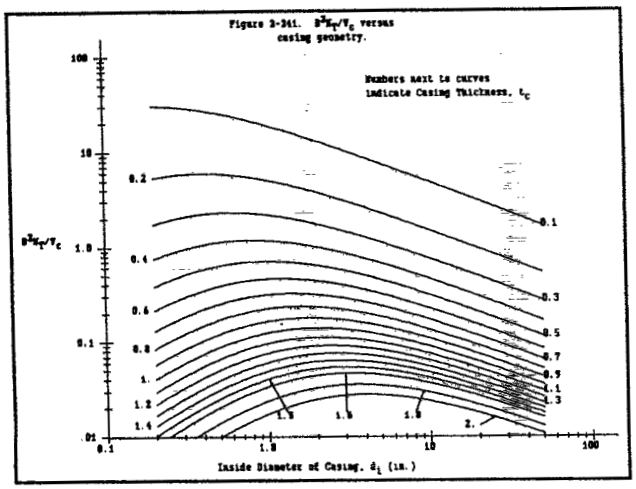

Figure 3. Fragment size parameters (Fig. 2-241, Ref. 1)

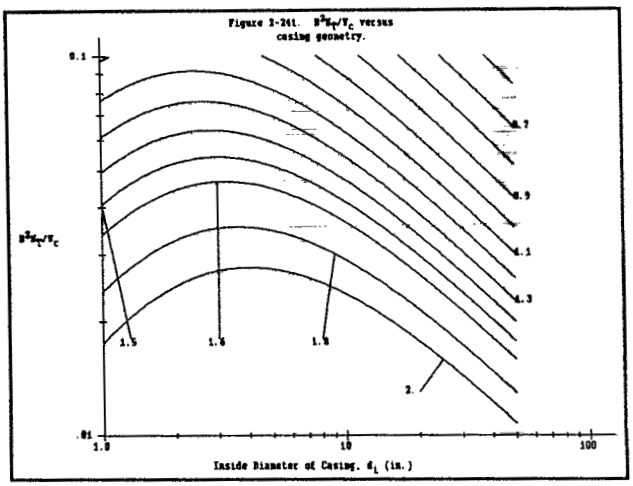

Figure 4. Zoomed Figure 2-241, Ref. 1

While data for most of the curves from the manual are stored in separate files, this was not a practical solution for recreating the response charts found in Volume 3 of the manual. Volume 3 contains over 200 response charts for maximum displacement, time of maximum response, and time of yield for a single-degree-of-freedom system with a bilinear resistance function due to a

bilinear loading. Since a closed-form solution for the response of these systems is mathematically awkward, a numerical method is generally used to find the displacement-time history. To adequately reproduce each of these figures with data points would require a large amount of storage space; however, since the numerical solution for the response is fairly straightforward, TM generates the response charts at run-time rather than reading the data from separate files. One advantage to this technique is that the user will not have to interpolate between charts when his loading does not match one of the loadings in the printed manual; all parameters for the loading are specified by the user. An example of a maximum response chart generated by TM is shown in Figure 5.

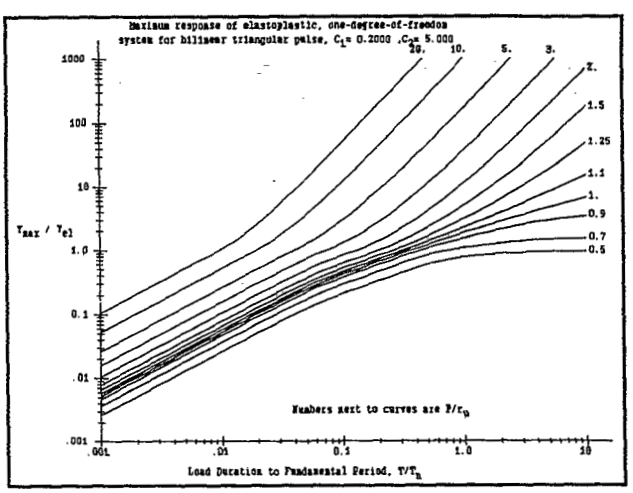

Figure 5. Response chart for bilinear pressure-time loading

Portability

The major routines of TM are written in ANSI standard FORTRAN-77. However, the program makes considerable use of assembly language subroutines to perform graphics operations, scroll menus, and achieve fast screen writing. TM achieves fast screen output by writing directly to display memory, bypassing the slower Basic Input/Output System (BIOS) video functions. Because of extensive use of assembler routines for menu generation and other video output, it would be difficult at best to move TM to another computer and/or operating system.

Graphics

All of the graphics routines used by TM were developed for microcomputers at WES. TM supports graphics on the following standard graphics adapters, and exploits the capabilities of certain "super" EGA's and VGA's.

Graphics Card	Resolution x Colors
Hercules Graphics Card	720 x 348 x 2
Color Graphics Adapter (CGA)	640 x 200 x 2

Enhanced Graphics Adapter (EGA)	640 x 350 x 16/64
Video Graphics Array (VGA)	640 x 480 x 16/256K

Plotters that support the Hewlett-Packard Graphics Language are also supported.

Availability

TM is currently in a draft stage and is being reviewed by the sponsors at the Department of Defense Explosive Safety Board (DDESB). When approved for release, the program will be available to government agencies from the DDESB.

REFERENCES

1. U.S. Army Armament Research, Development and Engineering Command, 1987, "Structures to Resist the Effects of Accidental Explosions," Picatinny Arsenal, New Jersey.